

Clean Up of Acid Whey

Effect of Heating and Washing on By-Product of Greek Yogurt Production

Lauren Tebben

Advisor: Tonya Schoenfuss, Ph.D.

Food Science and Nutrition Department

College of Food, Agricultural and Natural Resource Sciences

UNIVERSITY
OF MINNESOTA
Driven to DiscoverSM



Introduction

The demand for Greek yogurt has increased rapidly in the past several years as consumers seek out convenient, high protein snack and meal options. The production of Greek style yogurt involves separating whey from traditional yogurt, which increases the protein in the final product. However, the whey is highly acidic, creating problems for processing and the environment. A high lactic acid content and lack of high-value protein results in issues with processability (Sienkiewicz & Ridel, 1990). This results in economic and environmental issues with current land disposal methods (Zall, 1992). Currently, the industry has no profitable uses for this byproduct, and Greek yogurt manufacturers must pay for the disposal of acid whey. However, the whey does contain potentially valuable lactose and protein. Therefore, a cleanup method that allows for the isolation and utilization of these constituents presents an opportunity that could benefit the yogurt industry. Rather than paying a disposal fee, the acid whey could potentially be processed and sold as a value-added ingredient.

Objective

Develop a procedure for acid whey cleanup that allows for lactose recovery by examining the effects of heat and wash treatments on condensed and crystallized acid whey.

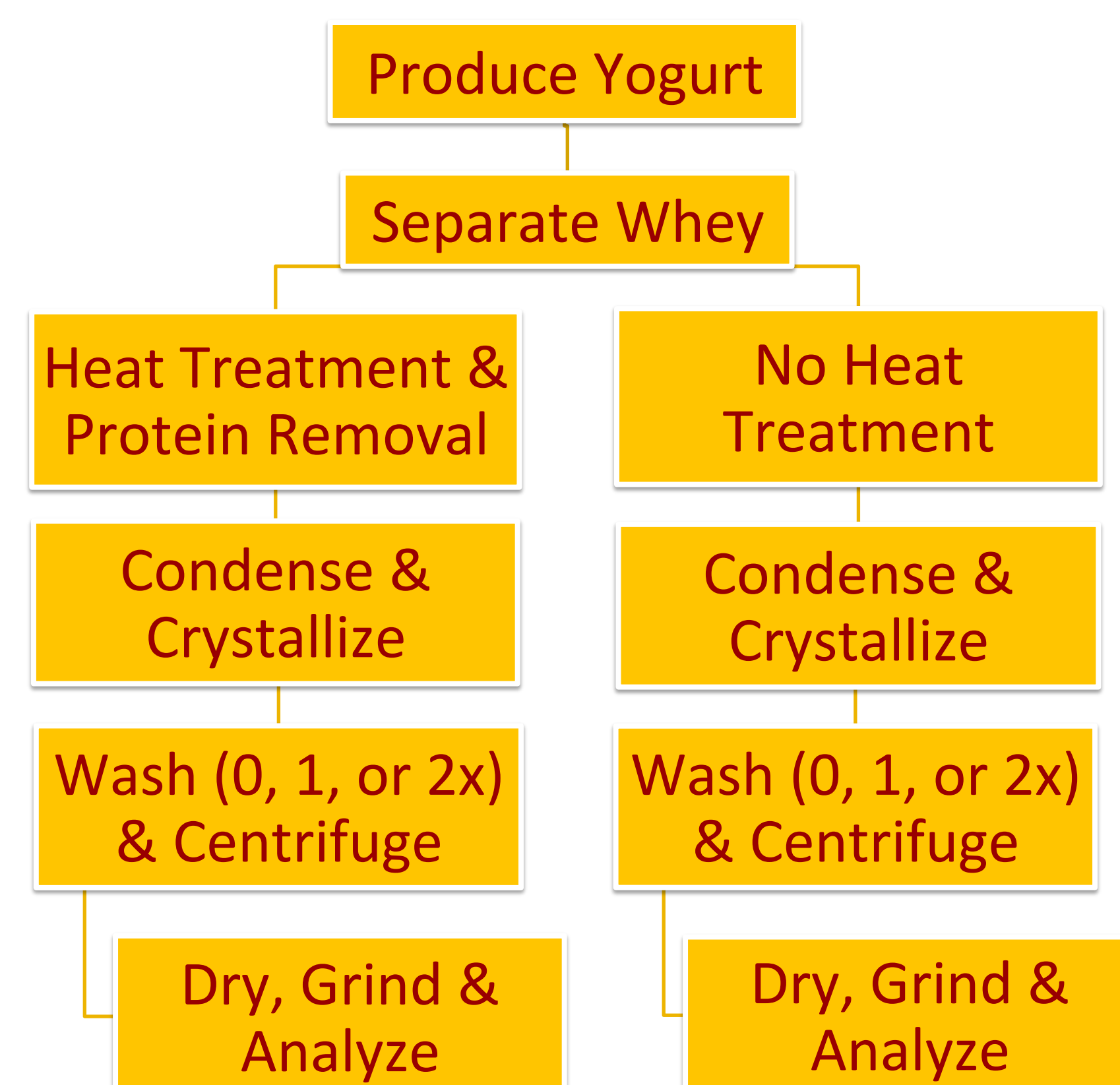


Figure 1: Research approach

Methods

- Yogurt Production:** Whole milk was heated to 66°C and held 30 minutes in a HotmixPRO thermal mixer. Cool to 43°C; add 2% w/w commercial plain yogurt as the source of starter cultures. Yogurt fermented in a 43°C water bath until pH was 4.6, then cooled to 25°C and stored in refrigerator.
- Whey Separation:** Yogurt was centrifuged in 50 mL tubes in a Beckman-Coulter GS-6R centrifuge at 2500 x *g* for 25 minutes. The acid whey (supernatant) was decanted and stored frozen.
- Heat Treatment:** Half of the whey was heat treated by heating on a hot plate at 80°C for 30 minutes to precipitate protein. The heated whey was centrifuged at 2500 x *g* for 12 minutes, and the supernatant was collected.
- Condensing:** Water was removed from the heated and unheated whey under vacuum using a rotary evaporator and a Genevac EZ-2 centrifugal evaporator to achieve approximately 60% solids, as measured on a refractometer using the Brix scale.
- Lactose Crystallization:** The condensed whey was refrigerated to allow the lactose, which has a low solubility, to crystallize.
- Washing:** After condensing, both the heated and unheated whey were divided into the following three portions:
 - No wash
 - 1 wash
 - 2 washes

Washing consisted of mixing the crystallized, condensed whey in a 2:1 ratio with reverse osmosis water, stirring, and centrifuging at 2500 x *g* for 6 minutes to remove the wash water.

- Drying:** All six samples were dried in a 70°C forced-draft oven for 24 hours. Dried samples were ground to a powder using a spice grinder and stored in a desiccator.



Figure 2: Dried and ground acid whey samples that were not heated (*top*) and heated (*bottom*) and had undergone 0, 1, or 2 wash treatments (*left to right*).

Methods of Analysis

Samples were analyzed in duplicate using for the following:

- Lactose: Megazyme Lactose Sucrose/D-Glucose assay kit (spectrophotometric method)
- Crude protein: Dumas, using protein conversion factor 6.38
- Ash: dry ashing at 550°C for 12 hours
- Moisture content: Karl Fischer
- pH: 0.65g dried whey dissolved in 10 mL water
- Color: measure Hunter *L*, *a*, and *b* with colorimeter

Results

Table 1. Average composition of condensed and dried acid whey samples

Heat Treatment	Wash	Lactose (%)	Ash (%)	Moisture (%)	Crude Protein (%)
Heat Treated	0	41.2	11.6	2.73	4.88
	1	54.2	9.50	3.08	4.41
	2	62.9	7.96	3.31	4.18
Not Heat Treated	0	37.9	11.0	2.45	9.23
	1	56.4	8.23	3.21	6.87
	2	58.3	6.94	3.71	6.05

Table 2: Average pH and color values of condensed

Heat Treatment	Wash	pH	Hunter <i>L</i> ^a	Hunter <i>a</i> ^b	Hunter <i>b</i> ^c
Heat treated	0	4.34	38.49	12.14	20.20
	1	4.43	55.55	9.40	21.66
	2	4.46	59.93	8.73	20.96
Not heat treated	0	4.37	44.32	12.31	23.75
	1	4.50	57.73	9.32	22.04
	2	4.53	53.77	9.76	21.13

^aHunter *L* values range from 0 (black) to 100 (white); a higher value indicates a lighter sample.

^bA more positive Hunter *a* value indicates more red color.

^cA more positive Hunter *b* value indicates more yellow color.

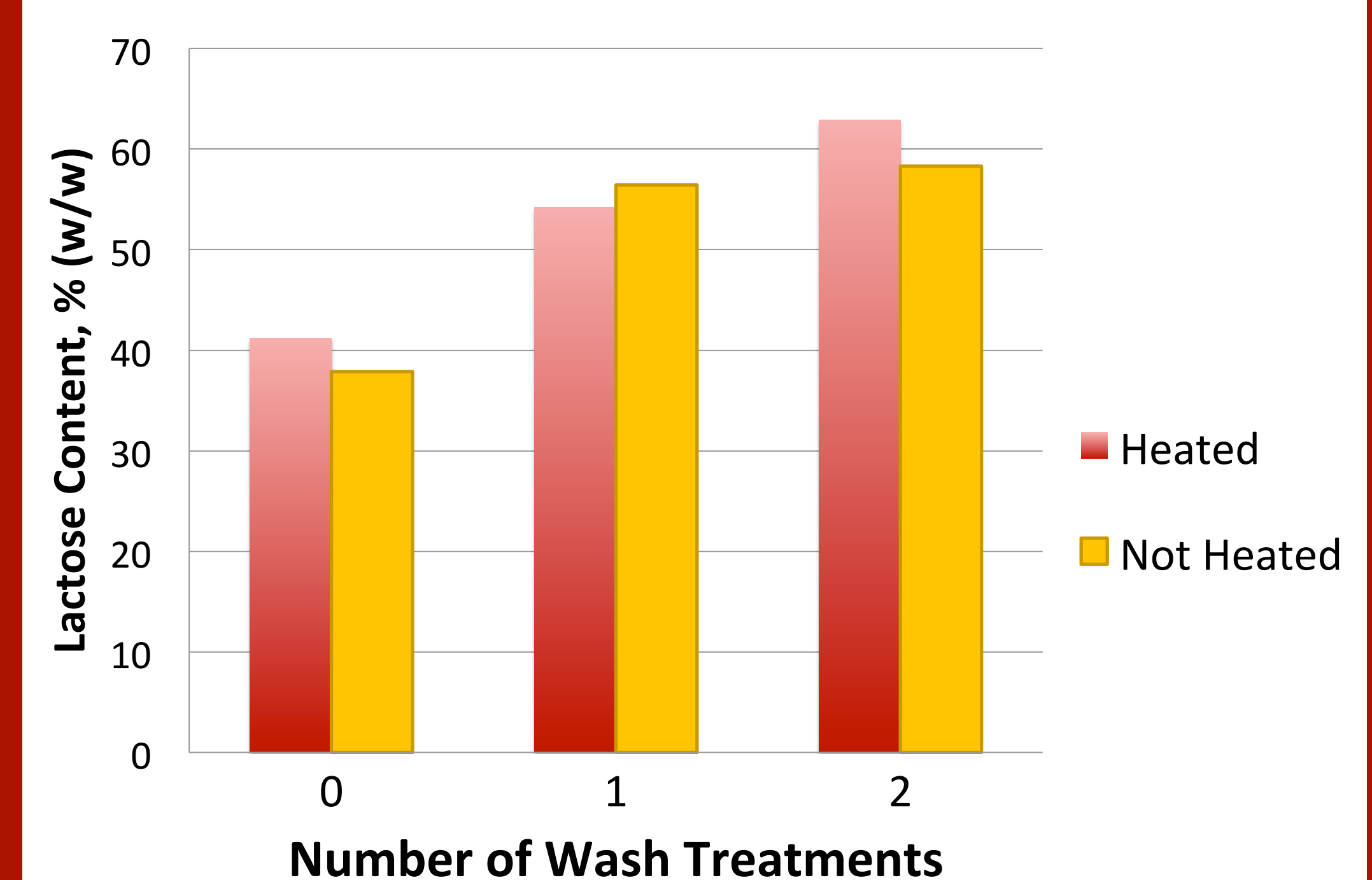


Figure 3: Effect of heating and wash treatments on lactose content in acid whey

Conclusion

Although the dried products were still acidic, both heating and washing increased the lactose content and decreased the protein content of the condensed whey. Further analysis is needed to determine if the treatments evaluated in this study are sufficient to allow the acid whey to be processed into other ingredients. Work is being conducted to determine if the condensed, treated whey can be processed to polymerize the lactose into a source of dietary fiber.

References

- Sienkiewicz, T., & Ridel, C.-L. (1990). *Whey and Whey Utilization* (2nd ed.). Buer, Germany: Verlag Th. Mann.
- Zall, R. R. (1992). Sources and Composition of Whey and Permeate. In J. G. Zadow (Ed.), *Whey and Lactose Processing* (pp. 1-72). New York: Elsevier.

Acknowledgements

Tonya Schoenfuss, faculty mentor; Catrin Tyl, post-doctoral associate; Geoffrey Dubrow and Alex Kuechel, graduate students. This research was supported by the Undergraduate Research Opportunities Program (UROP).